

Design Report & Stability Certificate

Site Address

The Proposed Construction of Affordable Housing Residential Apartment Building At Survey No: 127/2A, 127/1B1 & 127/1B2 of Kalapatti West [28] Village, Coimbatore North Taluk, Coimbatore District.

S.Subramaniam, MS.(Struc).PDQS.DRTM.

Registered Structural Engineer Grade – 1

CMDA : (SE/GR-I/24/02/008)

Kannimar Consultants

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Structural Design

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Chartered Engineer

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Stability Certificate

It is certified that The Proposed Construction of Affordable Housing Residential Apartment Building At Survey No: 127/2A, 127/1B1 & 127/1B2 of Kalapatti West [28] Village, Coimbatore North Taluk, Coimbatore District to resist for earthquake, check has been made and found safe and sound

and I hereby certify that

1. It is certified that among other factors, the proposed building has been designed to resist earthquake. I/We have checked various parameters and found that the proposed building would be safe.
2. I/We further certify that: The minimum grade of concrete is M25. The design and analysis have been done using the code of practice for plain and reinforced concrete as per IS 456-2000, design loads as per IS Codes No1893 and design of earthquake resistant structure as per IS Code No IS-875 part and seismic force as per the IS 1893 & IS456-2000
3. Minimum size of the column is 300 mm

S. Subramaniam, M.S.(Struc)., PDQS, DRTM.

Registered Structural Engineer Grade - I,

CGLDIS No. 3-I / 2019 / 05 / 005

New No. 14, Old No. 17A, Kannimar Villa,

Ganga Nagar, Jafferkhanpet, Ashok Nagar,

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Load calculation

Building Name: Residential flats
Number of Floor: Stilt + 5

Concrete Unit wt	25	kN/m ³
Brick work	20	kN/m ³
Live load -rooms	2	kN/m ²
Live load -stair&cordr	3	kN/m ²
Floor finish	1	kN/m ²
Floor Height		

Stilt floor	=	3 m	Parking
First floor	=	3.05 m	Residence
Second floor	=	3.05 m	Residence
Third floor	=	3.05 m	Residence
Fourth floor	=	3.05 m	Residence
Fifth Floor	=	3.05 m	Residence
Head room	=	2.8 m	

Load on Column

column

C2

X= 5.16

Y = 4.3

Sl. No	Description	No	L	B	D	Qty	UnitLoad	Total Load
Ground floor								
1	Column Load	1	0.3	0.6	5.5	0.99	25	24.75
2	Plinth beam	1	9.46	0.23	0.45	0.98	25	24.48
3	Roof beam	1	5.16	0.23	0.46	0.55	25	13.65
		1	4.3	0.23	0.46	0.45	25	11.37
4	Roof slab	1	5.16	4.3	0.14	3.11	25	77.66
5	Live load-all area	1	5.16	4.3	1	22.19	2	44.38
6	Floor finish	1	5.16	4.3	1	22.19	1.5	33.28
7	BW: up to FFL	1	9.46	0.23	0.75	1.63	20	32.64
8	BW: Above FFL							
	230 thick	1	0	0.25	0	0.000	20	0.00
	115 thick	1	0	0.15	0	0.000	20	0.00
								262.20
First floor								
1	Column Load	1	0.3	0.6	3.05	0.549	25	13.73
2	Roof slab	1	5.16	4.3	0.14	3.106	25	77.66
3	Roof beam	1	5.16	0.23	0.45	0.534	25	13.35
		1	4.3	0.23	0.46	0.455	25	11.37
4	Live load-all area	1	5.16	4.3	1	22.188	2	44.38
5	Floor finish	1	5.16	4.3	1	22.188	1.5	33.28
6	Brick wall-230 thick	1	0	0.25	2.6	0.000	20	0.00
7	Brick wall -115 thick	1	9.46	0.15	2.6	3.689	20	73.79
	Additional load	1	0	2.5	0.2	0.000	25	0.00
								267.55
Parapet load								
1	Brick wall	1	0	0.25	1	0	20	0
2	Weathering coarse material	1	5.16	4.3	0.1	2.22	20	44.38
								44.38

COLUMN TOTAL LOAD

column

C2

Sl.No	Description	Load
1	Stilt floor	262.20
2	First floor	267.55
3	Second floor	267.55
4	Third floor	267.55
5	Fourth floor	267.55
6	Fifth Floor	267.55
7	Terrace	44.38
8	Total	1644.35
	Say	170.00

Mt

COLUMN DESIGN

Column load as per load calculation

Long Column design as per IS456-2000, Page 71

Factored Load

Working load

PROCEDURE:

Length of column

Modulus of elasticity of concrete

Ref IS 456-2000 Cl 6.2.3.1

Flexural strength of concrete

Ref IS 456-2000 Cl 6.2.2

Maximum shear stress in concrete for limit state method of design

Ref IS 456-2000 Table 20 Cl 40.2.3

Permissible bearing stress

Permissible bearing stress

Column size

Minimum Eccentricity, e

One direction

Another Direction

Minimum eccentricity

Consider Minimum Eccentricity

0.05*b

Area of column

Number of rod

Area of Steel (A_{sc})

Area of Concrete (A_c)

% of Reinforcement

Column Load

Lateral Ties:

As per IS 456-2000; Clause 26.5.3.2.c-Page 49

Diameter shall not be less than

Provide

Spacing

Shall not be more than following

Least dimension of column

16x Smallest dia of column rod

Not more than

Minimum of above

Provide

Development length in compression

(F_y/1.15)

Page 43,26.2.1.1

SUMMARY

Column size

Rebar

Lateral tie

Bond stress for Compression

43,IS 456-2000

Grade of concrete	Type	M20	M25	M30	M35	M40 & above
Design Bond Stress, N/mm ²	Plain	1.5	1.75	1.875	2.125	2.375
	Deformed	2.4	2.8	3	3.4	3.8

$$= 170 \text{ Mt}$$

$$P_u = C_r(0.4 f_{ck} A_c + 0.67 f_y A_{sc})$$

$$P = P_u/1.5$$

$$C_r = 1.25 - [(l_e/D)/48]$$

$$F_{ck} = 25 \text{ N/mm}^2$$

$$F_y = 415 \text{ N/mm}^2$$

$$L = 3.75 \text{ m}$$

$$l_e = 3.19 \text{ m} \quad 0.85 * L$$

$$C_r = 0.96$$

$$E_c = 25000.00 \text{ N/mm}^2$$

$$f_{cr} = 3.50 \text{ N/mm}^2$$

$$t_{c \text{ max}} = 3.1 \text{ N/mm}^2$$

$$= 0.45 * F_{ck}$$

$$= 0.45 \times 25$$

$$= 11.25 \text{ N/mm}^2$$

$$= \frac{300}{300} \times \frac{600}{600} \text{ mm}$$

$$= L/500 + \text{Lateral dimension}/30$$

$$= 17.50 \text{ mm}$$

$$= 27.50 \text{ mm}$$

$$= 20 \text{ mm}$$

$$= 27.50 \text{ mm}$$

$$= 15.00 < 27.50$$

$$= 180000 \text{ mm}^2$$

$$= \frac{6}{4} \times \frac{25}{25} \quad 2944.88 \text{ mm}^2$$

$$= \frac{4}{4} \times \frac{25}{25} \quad 1963.25 \text{ mm}^2$$

$$= 4908.13 \text{ mm}^2$$

$$= 175091.88 \text{ mm}^2$$

$$P_u = 2994977.182 \text{ N}$$

$$P = 1996651.455 \text{ N}$$

$$\text{Say } = 199.67 \text{ Tonne}$$

$$0.8 < 2.73 < 4 \%$$

$$\text{SAFE} > 170.00 \text{ Mt}$$

$$\text{SAFE}$$

$$= \frac{25}{4}$$

$$= 6.25 \text{ mm dia}$$

$$= 10 \text{ mm dia}$$

$$= 300 \text{ mm}$$

$$= 400 \text{ mm}$$

$$= 300 \text{ mm}$$

$$= 300 \text{ mm}$$

$$10 @ 150 \text{ mm C/c}$$

$$L_d = \frac{\phi * \sigma_s}{4 * f_{bd}}$$

$$\phi = \text{Dia of bar} = 25.00 \text{ mm}$$

$$\sigma_s = \text{Stress in bar} = 360.87 \text{ N/mm}^2 \quad (0.87 * F_y)$$

$$f_{bd} = \text{Bond stress} = 2.8 \text{ N/mm}^2$$

$$L_d = \frac{25}{4} \times \frac{360.8696}{2.8}$$

$$L_d = \frac{4}{805.512} \text{ mm}$$

$$L_d = 805.512 \text{ mm}$$

$$L_d = \frac{300}{6} \times \frac{25}{25}$$

$$L_d = \frac{4}{4} \times \frac{25}{25}$$

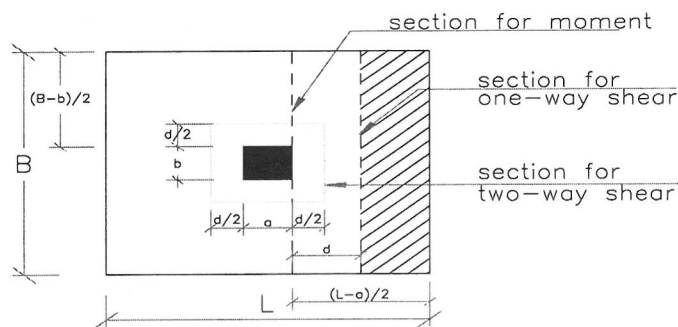
$$L_d = 150 \text{ mm C/c}$$

$$10 @ 150 \text{ mm C/c}$$

Isolated Footing- Regular

Load on Column(P)	=	170 Mt					
	=	1700 kN					
Ultimate column Load $P_u = (1.5 \times P)$	=	2550 kN					
Self Weight of footing(0.1P)	=	156.8 kN					
Total Load on column	=	1856.8 kN					
SBC of soil	=	250 kN/m ²					
f_{ck}	=	25 N/mm ²					
f_y	=	415 N/mm ²					
T_c max	=	3.1 N/mm ²	IS456-2000,P73				
$X_{u\max}/d$	=	0.48	IS456-2000,P70				
Assume footing concrete depth	=	800 mm	0.8				
Column Size							
		<table><tr><td>a</td><td>b</td></tr><tr><td>0.3</td><td>0.6</td></tr></table>	a	b	0.3	0.6	m
a	b						
0.3	0.6						
		300	600 mm				
Column rod size	=	25	mm				
Foundation depth	=	1	m				
Area of footing, A	=	1870.00					
		250.00					
	=	7.48 m ²					
		2.73 m					
Size of footing							
Adopt footing size		<table><tr><td>L(m)</td><td>B(m)</td></tr><tr><td>2.8</td><td>2.8</td></tr></table>	L(m)	B(m)	2.8	2.8	
L(m)	B(m)						
2.8	2.8						
		7.84 m ²					
Footing area provided							
Net upward pressure(P/A)	p	216.84	< 250 kN/m ²				
			Safe				
Ultimate Design Pressure	(1.5 xp)	325.26 kN/m ²					

Depth Required for B M Consideration



Max. BM along column edge	=	$\frac{P \times B \times (L-a)^2}{8}$					
	=	216.84					
	p	216.84					
	B	2.8					
	L-a	2.8					
	$(L-a)^2$	6.25					
BM	=	216.84					
	=	2.8					
	=	6.25					
	=	474.33					
Max. BM	=	474.33 kN.m	0.273				
M_u Limit	=	$0.138 f_{ck} b d^2$					
	=	<table border="1"> <tr> <td>0.138</td><td>25</td><td>1000</td><td>527076</td></tr> </table>	0.138	25	1000	527076	
0.138	25	1000	527076				
	=	1818412200.00 Nmm					
	=	1818.41	> 474.33				
	=	M_u limit	> M_u				
	=		Safe				
$M_u(1.5 \times BM)$	=	711.50 kN.m					

d^2	=	<table><tr><td>M_u</td></tr><tr><td>$0.36f_{ck} (X_u/d)(1-.416X_u/d) 1000$</td></tr></table>	M_u	$0.36f_{ck} (X_u/d)(1-.416X_u/d) 1000$		
M_u						
$0.36f_{ck} (X_u/d)(1-.416X_u/d) 1000$						
d^2	=	$\frac{711495535.71}{3457.38}$	d'	=	50 cover	
d	=	453.64 mm		=	16 footing mc	
D	=	800 mm	0.8	Safe	8	
d	=	726 mm	m	0.726 m	74	
Check For Gross Bearing Capacity						
Service Load	=	1700 kN	Single shear	Safe		
Weight Of footing	=	156.80 kN				
Weight Of soil	=	25.1 kN				
Total	=	1881.9 kN				
Check For Gross Bearing Capacity	=	$\frac{1881.89}{7.84}$	240.04			
Area of Tension steel for BM						
BM	=	$0.87 \times F_y \times A_t (d - F_y \times A_t / F_{ck} \times b)$				
711495535.7	=	262122.3 A_t	-		$2.141 A_t^2$	
a	=	2.141				
b	=	262122.3				
c	=	711495535.7				
2a	=	4.28				
b^2	=	68708100157				
4ac	=	6091855269				
sqrt of $b^2 - 4ac$	=	250232.38				
A_t	=	2777.36 mm ²				
Per Rm	=	991.91 mm ²				
Alternative method						
M_u/bd^2	=	0.482				
P_t	=	0.137 %				
	=	2778.78 mm ²				
Minimum Rebar	0.12%	=	871.2 mm ²			
Adopt	=	991.91 mm ²				
	16	mm	140	mm c/c		
1435.98	>	991.91 mm ²		Per Rm		
The design is	Safe					
P_t	=	0.20 %				

Depth Required for Punching shear

Single Shear :Critical section is taken at distance "d" from the face of the column

Shear Force	V	=	<table><tr><td>Shear area</td><td>x</td><td>Pressure</td></tr><tr><td>2.8</td><td>m</td><td></td></tr><tr><td>0.52</td><td>m</td><td></td></tr><tr><td>1.47</td><td></td><td></td></tr></table>			Shear area	x	Pressure	2.8	m		0.52	m		1.47		
Shear area	x	Pressure															
2.8	m																
0.52	m																
1.47																	
Shear area	L	=															
	b	=	0.52 m														
area		=	1.47														
	V	=	<table><tr><td>216.84</td><td>x</td><td>1.47</td></tr></table>			216.84	x	1.47									
216.84	x	1.47															
	V	=	318.14 kN														
	V _u	=	477.21 kN														
	T _v	=	V _u														
		=	bd														
		=	<table><tr><td>477214.29</td><td></td></tr><tr><td>2800</td><td>726</td></tr></table>			477214.29		2800	726								
477214.29																	
2800	726																
Nominal Shear Stress	T _v	=	0.235 N/mm ²														
Percentage of steel provided	P _f	=	0.20 %														
Shear strength of concrete	T _c	=															
Percentage of steel	P _f	=	0.20 %														

Permissible shear stress in concrete ($k t_c$) for solid slabs in limit state design method

Ref IS 456:2000 Cl 40.2.1.1, Table 19

f_{ck} N/mm ²	P_t %	D of slab	k	$k t_c$ N/mm ²
25	0.20	800	1.00	0.33

		0.235	<	0.33	N/mm ²
		T _v	<	kT _c	
	The design is Safe				
Double Shear :Critical section is taken at distance "0.5d" from the face of the column					
	Footing area	=	7.84 m ²		
	Critical section area	=	1.026	x	1.326
		=	1.36 m ²		
	Net area	=	6.48 m ²		
Shear Force		=	Shear area	x	Pressure
			6.48	x	216.84
	V		1405.00 kN		
SF	V _u	=	2107.50 kN		
	T _v	=	V _u		
		=	bd		
	b	=	4704 mm		
	d	=	726		
		=	2107498.24		
		=	4704	x	726
Nominal Shear Stress		=	0.62 N/mm ²		
	T' _c	=	K _s .T _c		
	K _s	=	0.5+Bc		
	Bc	=	0.50 (a/b)		
	K _s	=	1.00		
Ks Not more than		=	1		
	K _s	=	1		
	T _c	=	1.250 (0.25*sqrt(Fck))		
	T' _c	=	1.250		
	T _v	<	T' _c		
	0.62	<	1.250 N/mm ²		
	Safe				
Transfer of force at the base of the column					
	P _u	=	2550 kN		
Compressive bearing resistance		=	0.45fck * area of column		
		=	2025.00	<	2550 kN
Consider Longitudinal rebar for bond					
Development length in Compression					
	L _d	=	$\frac{\phi * \sigma_s}{4 * T_{bd}}$		
	Ø	=	Dia of bar = 25 mm		
(0.87*Fy)	σ _s	=	Stress in bar(Fy/1.15) = 361.05 N/mm ²		
Page 43,26.2.1.1	T _{bd}	=	Bond stress = 2.4 N/mm ²		
	L _d	=	25	361.05	
			4	2.4	
Required Development Lenth	L _d	=	940.2	mm	
Available Development Lenth		=	1176.0	>	940.2 mm
	Safe				
SUMMARY					
	Footing Size	=	2.8	x	2.8 M
	Footing concrete depth	=			800 mm
	Footing rod	=	16	@	140 mm c/c

Bond stress for **Compression** P 43,IS 456-2000

Grade of concrete	Type	M20	M25	M30	M35	M40 & above
Design Bond Stress,N/mm ²	Plain	1.5	1.75	1.875	2.125	2.375
	Deformed	2.4	2.8	3	3.4	3.8

PLINTH BEAM

Span	=	5.25 m		
Wall thickness-Below basement	=	0.23 m		
Wall height	=	0.75 m		
Wall thick-above basement	=	0.25 m		
Wall height	=	0 m		
Beam Size b	=	230 mm		
D	=	375 mm	l/16	328 mm
d'	=	46 mm	d'/d =	0.140
d	=	329 mm		
F _y	=	415 N/mm ²		
F _{ck}	=	25 N/mm ²		

LOAD CALCULATIONS:

Self wt = b x D x l x 25	=	2.16 kN/m
Brick masonry weight below basement	=	3.45 kN/m
Brick masonry weight above basement	=	0
Max Udl	w =	5.61 kN/m
Max B.M at Mid span	=	(wl ² /20)

5.61	5.25	5.25
	20	

BM	=	7.73 kN.M
SF	=	wl/3 (0.5 x w x l)

5.61	x	5.25
	3	

SF	=	9.81 kN
M _u /bd ²	=	1.5
	=	7.73
	=	1000000
	=	230.00
	=	329
	=	329

	=	0.47 N/mm ²
--	---	------------------------

Refer SP 16 ,Page 86,Pt

A _{st}	=	0.132	%	P _c	=	0.1
	=	0.132	230			
	=		100			

A _{st}	=	100 mm ²			=	76 mm ²
-----------------	---	---------------------	--	--	---	--------------------

Provide

2	16
1	12
0	16

"A_{st}" Provided

515.16

SAFE

99.80

2	16
1	12
0	12

515.1568

SAFE

75.67

Min.Reinf = (0.87 x b x d / F_y) mm²

0.870	230	329
	415	

Min.Reinf = 158.633 mm²
"A_{st}" Provided 515.2 > 158.6 mm²

SAFE

CHECK FOR SHEAR STRENGTH

T _c Max	=	0.62 *sqrt(F _{ck})
	=	0.62
	=	5
	=	3.10 N/mm ²

As per clause 40.2 (P73)
of IS 456-2000
Percentage of steel
Shear strength

P _t	=	0.68	%
	=	kT _c	
k	=	1	
		% of steel	T _c
		0.5	0.49
		0.75	0.57

For	0.68	0.55		
kT _c	=	1.00	X	0.55
kT _c	=	0.55	N/mm ²	<
T _v	=	V _u /b.d		SAFE
V _u	=	1.5	X	9.81

Nominal Shear stress

Now

		14.716 kN		
T _v	=	V _u /b.d		
T _v	=	14.72	1000	
	=	230.00	329	
T _v	=	0.19	<	3.10 N/mm ²

0.19 < 0.55 N/mm²
SAFE

T_v < kT_c

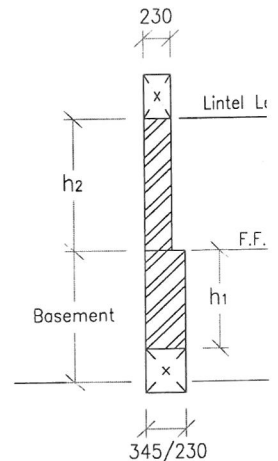
SAFE

Total shear strength	V _u	=	14716.41 N
Shear contribution by concrete	T _c b.d	=	0.55
		=	41456.1176

Shear contribution by steps	V _{us}	=	V _u	-	T _c b.d
		=	14716.41	-	41456.12
		=	-26739.71 N		
		=	-447 mm C/C		

Provide

Y 8



Area or 2 legged stps
Spacing of stirrups

$$a = \frac{0.87 \cdot F_y \cdot a \cdot d}{V_{us}}$$

0.87	415	101	329
-26739.71			

-447 mm C/C

Provide shear Rebar without
considering conc. shear
Area or 2 legged stps

Y 8 811 mm C/C

$$a = \frac{0.87 \cdot F_y \cdot a \cdot d}{V_u}$$

0.87	415	101	329
14716.41			

811 mm C/C

V_{us}/d

-26739.71	10
329.00	1000

-0.813 kN/cm

Minimum Stirrups Reinforcement

Y 8

A_{sv} 100.52 mm²

S_v 0.87*Fy*Asv/0.4*b

0.87	415	101
0.4	230.00	

36292.16832

92

Maximum Spacing of Stirrups

394 mm C/C

0.75 * d

246.75 mm

300 mm

246.75 mm

Least of above

Provide

394 > 200 < 246.75

SAFE SAFE

531 > 200 < 811

SAFE SAFE

Development length In Tension

Ld = $\frac{\phi \cdot \sigma_s}{4 \cdot T_{bd}}$

ϕ Dia of bar = 16 mm

σ_s (0.87*Fv) Stress in bar(Fy/1.15) = 360.87 N/mm²

Page 43.26.2.1.1 T_{bd} Bond stress = 2.24 N/mm²

16	360.8695652
4	2.24

Ld = 644.4 mm

Bond stress for tension

P 43,IS 456-2000

Grade of concrete	Type	M20	M25	M30	M35	M40 & above
Design Bond Stress,N/mm ²	Plain	1.2	1.4	1.5	1.7	1.9
	Deformed	1.92	2.24	2.4	2.72	3.04

Centre Beam-Continues

Span	=	5.25 m		
Lateral span	=	7 m		
Wall height	=	0 m		
Wall thickness	=	0.15 m		
b	=	230 mm		
D	=	450 mm	l/12.5	420 mm
d'	=	50 mm	d'/d =	0.125
d	=	400 mm		
f _y	=	415 N/mm ²		
f _{ck}	=	25 N/mm ²		

Slab Load:

Self wt	=	3.5 kN/m ²	slab thk	0.14 m
Live Load	=	2 kN/m ²		
Floor Finish	=	1.5 kN/m ²		
Mish. Load	=	0 kN/m ²		
	=	7 kN/m ²		

Load Calculations:

Brick work/ AAC Block	=	20 kN/m ³
Self wt = b x D x 1 x 25	=	2.59 kN/m
Brick work:	=	0.00 kN/m
Udl for slab	=	16.33 kN/m
Max Udl	w =	18.92 kN/m
M _u Limit	=	0.138 f _{ck} b d ²

0.138	25	230	160000
-------	----	-----	--------

126960000.00 Nmm

126.96 > 71.11

M_u limit > M_u

Singly Reinforced

"d" - reqd = 299.37 < 400 mm

Safe

Max B.M at Mid span

(w l²/13)

18.92	5.25	5.25
	13	

40.12 kN.M

BM

M_u Midspan

60.17 kN.M

Max B.M at Support

(w l²/11)

18.92	5.25	5.25
	11	

47.41 kN.M

BM

M_u Support

71.11 kN.M

SF

w l/2

(0.5 x w x l)

18.92	x	5.25
	2	

49.67 kN

SF

M_u/b d² @Mid span

1.5	40.12	1000000
230.00	400	400

1.64 N/mm²

M_u/b d² @Support

1.5	47.41	1000000
230.00	400	400

1.93 N/mm²

Rebar @ Mid span

Refer SP 16 ,Page 86,Pt

P _t	P _c
0.494	0.25

0.494 %

A_{st}

0.494	230	400
	100	

Provide	A_{st}	=	454	mm^2		=	227	mm^2													
			<table><tr><td>2</td><td>16</td></tr><tr><td>2</td><td>16</td></tr><tr><td>0</td><td>16</td></tr></table>	2	16	2	16	0	16					<table><tr><td>2</td><td>16</td></tr><tr><td>0</td><td>20</td></tr><tr><td>0</td><td>16</td></tr></table>	2	16	0	20	0	16	
2	16																				
2	16																				
0	16																				
2	16																				
0	20																				
0	16																				
"A _{st} " Provided	804.15	>	454.07	mm^2		402.0736	>	227.03													
	0.87	Safe				0.44	Safe														

Rebar @ Support

Refer SP 16 ,Page 86,Pt

Refer SP 16 ,Page 86,Pt

P_t	P_c
0.594	0.297

0.594

%

A_{st}

0.594	230	400
	100	

Provide

A_{st}

547	mm^2
2	16
2	16
0	16

=	273	mm^2
2	16	
2	20	
0	16	

"A_{st}" Provided

804.15

>

546.56

mm^2

1030.314

>

273.28

0.87

Safe

1.12

Safe

Min.Reinf

$=$

$0.87 \times b \times d / F_{y1}$

mm^2

0.870	230	400
	415	

Min.Reinf

$=$

192.867

mm^2

"A_{st}" Provided

804.1472

>

192.867

mm^2

Safe

Min. % of steel required

As per Cl.26.5.1.1 IS456:2000

As per Cl.6.2.1 IS13920:1993

$P_{t \min}$	$=$	0.205 %			
	$=$	0.290 %	$(0.24 \sqrt{f_{ck}}) / f_{y1}$		
	$=$	0.290 %	$<$	0.87 %	
			Safe		

Max. % of steel to be used

As per Cl.26.5.1.1 IS456:2000

As per Cl.6.2.1 IS13920:1993

$P_{t \max}$	$=$	4.000 %			
	$=$	2.500 %			
	$=$	2.500 %	$>$	0.87 %	
			Safe		

CHECK FOR SHEAR STRENGTH

As per clause 40.2 (P73) of IS 456-2000

Tc Max	=	0.62 *sqrt(Fck)		
	=	<table border="1"><tr><td>0.62</td><td>5</td></tr></table>	0.62	5
0.62	5			
	=	3.10 N/mm ²		
Pt	=	0.87 %		

Permissible shear stress in concrete ($k t_c$) for solid slabs in limit state design method

Ref IS 456:2000 Cl 40.2.1.1, Table 19

f_{ck} N/mm^2	p_t %	D of slab	k	$k t_c$ N/mm^2
25	0.87	450	1.00	0.61

	Now	kT_c	=	0.61	N/mm^2	<	3.10 N/mm^2				
Nominal Shear stress		T_v	=	$V_u/b.d$		Safe					
		V_u	=	1.5	X	49.67					
				74.501							
		T_v	=	$V_u/b.d$							
			=	<table border="1"> <tr> <td>74.50</td> <td>1000</td> </tr> <tr> <td>230.00</td> <td>400</td> </tr> </table>	74.50	1000	230.00	400			
74.50	1000										
230.00	400										
			=	0.81	<	3.10	N/mm^2				
					Safe						
	0.81		>	0.61	N/mm^2						
	T_v		>	kT_c							
				Provide shear Bar							

SLAB DESIGN AS PER BIS-2000 METHOD

Location:

$$\begin{aligned} L_x &= 4.98 \text{ m} \\ L_y &= 5.25 \text{ m} \\ f_{ck} &= 25 \text{ N/mm}^2 \\ f_y &= 415 \text{ N/mm}^2 \\ L_y/L_x &= 1.05 \end{aligned}$$

Two Way Slab

$$\begin{aligned} \text{Span} &= 4.98 \text{ m} & \text{Span/32} \\ \text{Slab thickness} &= 150 \text{ mm} & 155.6 \\ \text{Cover} &= 20 \text{ mm} \\ \text{Effective depth} &= 130 \text{ mm} \\ \text{Concrete wt} &= 25 \text{ kN/m}^3 \\ \text{Live Load on Slab} &= 2 \text{ kN/m}^2 \\ \text{Floor finish} &= 1.5 \text{ kN/m}^2 \end{aligned}$$

Design Load:

$$\begin{aligned} \text{slab weight} &= 3.75 \text{ kN/m}^2 \\ \text{Live + Floor finish Load} &= 3.5 \text{ kN/m}^2 \\ \text{Total Load} &= 7.25 \text{ kN/m}^2 \end{aligned}$$

$$\begin{aligned} M_x &= \alpha_x w l_x^2 \\ M_y &= \alpha_y w l_x^2 \end{aligned}$$

As per IS456-2000-Table 26-Page No:91

Negative Moment at edge

$$\begin{aligned} L_y/L_x &= 1.05 \\ \alpha_y &= 0.047 \end{aligned}$$

		Ly/Lx		For
		1	1.1	1.05
Negative Moment @ edge	α_x	0.047	0.053	0.050
Positive Moment at mid span	α_x	0.035	0.040	0.038

$$\begin{aligned} M_x &= 9.04 \text{ kNM} \\ M_y &= 8.45 \text{ kNM} \\ \text{Maximum Bm} &= 9.04 \text{ kNM} \\ \text{"d" - reqd under compression} &= 62.68 < 130 \text{ mm} \end{aligned}$$

M_{ux}	M_{uy}
13553455.95	
	12676104

$$M_u/b.d^2 = \frac{M_{ux}}{b.d^2} = 0.80 \quad \frac{M_{uy}}{b.d^2} = 0.75 \quad \text{N/mm}^2$$

As per SP16, Table 2,Page 48,

$$P_t = \frac{M_u}{b.d^2} = 0.231 \quad \text{mm}^2$$

Area of steel

Adopt

$$\begin{aligned} Y & \begin{array}{|c|c|} \hline 10 & 140 \\ \hline \end{array} \text{ mm C/C} & \begin{array}{|c|c|} \hline 10 & 140 \\ \hline \end{array} \text{ mm C/C} \\ 560.93 & > 300.43 & 560.93 & > 280.23 \\ \text{Safe} & & \text{Safe} \end{aligned}$$

Positive Moment at mid span

$$\begin{aligned} \alpha_y &= 0.043 \\ M_x &= 6.78 \text{ kNM} \\ M_y &= 7.73 \text{ kNM} \\ \text{Maximum Bm} &= 7.732 \text{ kNM} \end{aligned}$$

M_{ux}	M_{uy}
10170778.5	
	11597287

$$M_u/b.d^2 = \frac{M_{ux}}{b.d^2} = 0.60 \quad \frac{M_{uy}}{b.d^2} = 0.69 \quad \text{N/mm}^2$$

As per SP16, Table 2,Page 48,

$$P_t = \frac{M_u}{b.d^2} = 0.172 \quad \text{mm}^2$$

Area of steel

Adopt

$$\begin{aligned} Y & \begin{array}{|c|c|} \hline 10 & 140 \\ \hline \end{array} \text{ mm C/C} & \begin{array}{|c|c|} \hline 10 & 140 \\ \hline \end{array} \text{ mm C/C} \\ 560.93 & > 223.16 & 560.93 & > 255.5 \end{aligned}$$

Check for Shear strengthAs per clause 40.2 (P72)
of IS 456-2000

Safe

$$T_c \text{ Max} = 0.62 \sqrt{f_{ck}}$$

0.62	5
------	---

$$= 3.10 \text{ N/mm}^2$$

For slab as per 40.2.3.1

$$T_c \text{ Max} = 0.5 T_{c \text{ max}}$$

0.50	3.10
------	------

$$= 1.55 \text{ N/mm}^2$$

Percentage of steel

$$P_t = 0.43 \%$$

Shear strength

$$= k t_c$$

Safe**Permissible shear stress in concrete ($k t_c$) for solid slabs in limit state design method**

Ref IS 456:2000 Cl 40.2.1.1, Table 19

f_{ck} N/mm ²	P_t %	D of slab	k	$k t_c$ N/mm ²
25	0.43	150	1.30	0.60

Now, $k t_c$

$$k t_c = 0.60 < 1.55 \text{ N/mm}^2$$

Safe

Nominal Shear stress

$$T_v = V_u / b.d$$

$$V_u = 27.07875 \text{ kN}$$

$$T_v = 0.21 < 1.55 \text{ N/mm}^2$$

Safe

$$T_v < k T_c$$

Safe

Check for Deflection

Live Load

$$2 < 3.01 \text{ kN/m}^2$$

Deflection calculation is Not Necessary

$$A_{st \text{ required}} = 223.16 \text{ mm}^2$$

$$A_{st \text{ Provided}} = 560.93 \text{ mm}^2$$

Steel stress for service Load

$$F_s = 0.58 \times F_y \times \frac{A_{st \text{ required}}}{A_{st \text{ Provided}}}$$

As per Fig-4, IS 456-2000, Page 38

0.58	415	223.16
	560.93	

$$F_s = 95.76 \text{ N/mm}^2$$

Percentage of steel provided

$$= 0.43 \%$$

Modification factor-Fig-4

As per IS 456-2000-Page 38

f_y	f_s	$P_{t \text{ req.}}$	$P_{t \text{ prov.}}$	MF_t
N/mm ²	N/mm ²	%	%	IS 456 Fig 4
415	95.76	0.17	0.43	2.00

Effective depth ratio

For, Simply supported

$$= 20$$

Continues

$$= 26$$

Cantilever

$$= 7$$

(Lx/d) Max

$$= 26 \times 2.000$$

$$= 52.00$$

(Lx/d) Provided

$$= 4980$$

$$= 130$$

(Lx/d) Max

$$52 > 38.31 \text{ (Lx/d) Provided}$$

Safe**Maximum diameter of bars for slabs**

Ref IS 456-2000 Cl 26.5.2.2

D of slab mm	dia of bar mm	Result Cl 26.5.2.2
150	10	Ok

STAIRCASE -DOG LEGGED MODEL

Location:

L_x	=	5.97 m		
F_{ck}	=	25 N/mm ²		
F_y	=	415 N/mm ²		
Step weight	=	20 kN/m ³		
Landing width	=	1.2		
Slope length	=	3.57		
Step tread	=	0.25 m		
Step riser	=	0.165 m		
Slope length for one step	=	0.300 m		
Number of tread	=	3.57		
	=	0.25		
	=	14.28	No	
Say	=	11	No	
Additional slope length per flight	=	11	x	0.050
	=	0.54		
Effective length	=	6.51	m	
Concrete wt	=	25 kN/m ³		
Waist slab thickness	=	0.150 m	(Assumed)	
Loads:				
Dead load of Waist slab	=	3.75 kN/m ²		
Ceiling finish	=	0.25 kN/m ²		
Sub total	=	4 kN/m ²		
Dead Load on plan area	=	4.00	x	0.300
	=			0.25
	=	4.79 kN/m ²		
Brick load	=	0.165	x	20
	=			2
	=	1.65 kN/m ²		
Live load	=	3 kN/m ²		
Floor finish	=	1.5 kN/m ²		
Total load on staire	=	10.94 kN/m ²		
Maximum BM($w \times l^2 / 12$)	=	10.94	x	6.51 ²
	=			12
	=	38.70 kN.M		
M_u	=	1.5	x	38704768
	=	58057152.47 Nmm		
		58057152.47		
		0.138	25	1000
		16828.16		
sqrt	=	129.72 mm		
Cover	=	20.00 mm		
Total	=	149.72 mm		
Provide	=	150.00 mm		
d	=	127.00		
$M_u / b.d^2$		58057152.47		
		1000.00	127.00	127.00
		3.60		
As per SP16, Table 2,Page 48,				
P_t	=	1.262	%	
Area of steel	=	1.261732811	x	1000 x 127.00

$$= 1602.40 \text{ mm}^2$$

Provide minimum steel

$$= 0.12\%$$
$$= 152.4 \text{ mm}^2$$

Y 10 150 mm C/C
524 > 152 mm²
Safe

Percentage of steel

$$P_t = 1.27 \%$$

$$= kT_c$$
$$k = 1.2$$

% of steel	T_c
1	0.64
1.25	0.7

For $\frac{1.27}{0.70} \text{ N/mm}^2$

$$kT_c = \frac{1.200}{0.845} \times 0.704$$

$$T_v = V_u / b.d$$

V_u	1.5	6.51	10.94
		2	

V_u	=	53.4682	kN	
T_v		53.4682	x	1000
		1000	x	127.00

$$\begin{aligned} T_v &= 0.4210 < 0.8447 \\ T_v &< kT_c \end{aligned}$$

SAFE

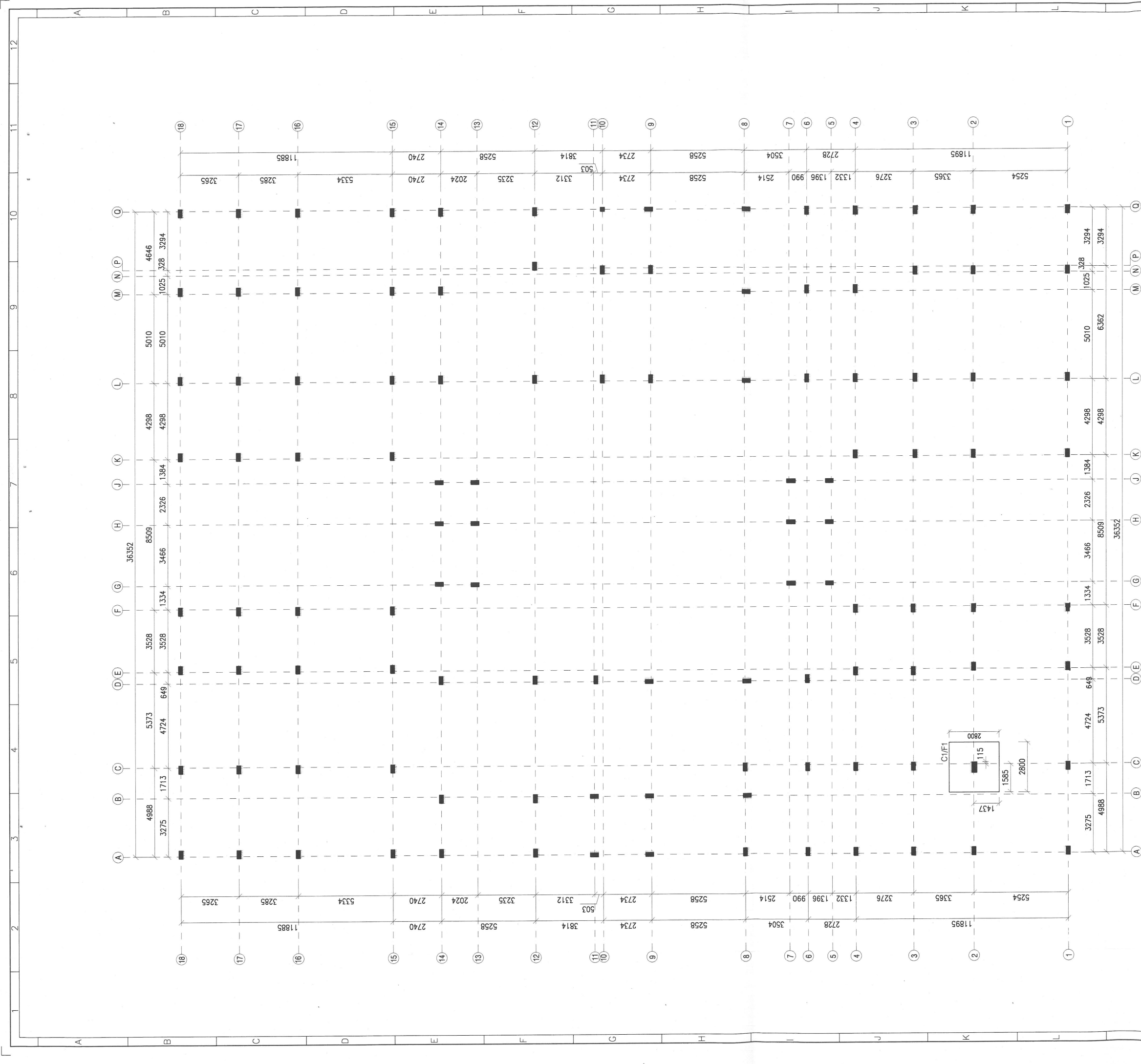
= 150.00 mm

= Y 16 @ 125 mm C/C

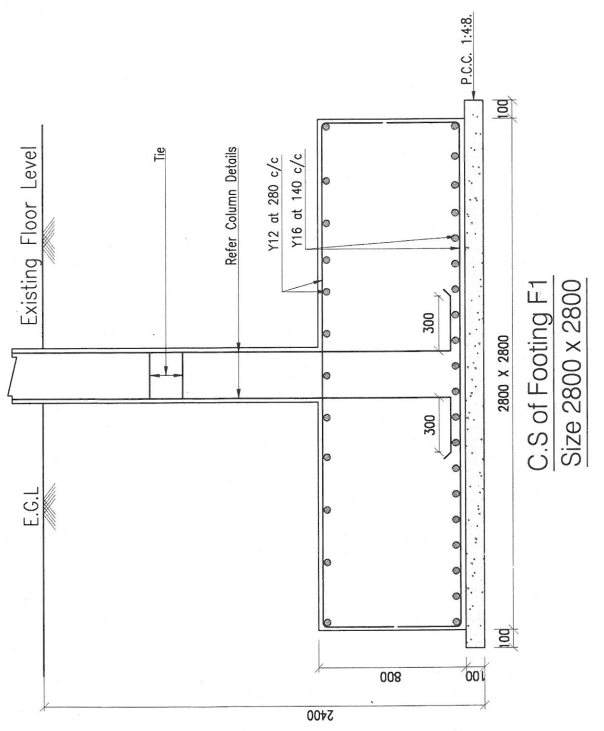
= Y 10 @ 150 mm C/C

SUNSHADE DESIGN

1	Grade of concrete	F_{ck}	=	25 N/ mm ²	
2	grade of steel	F_y	=	415 N/ mm ²	
3	Width of sunshade		=	0.6 m	
4	Sunshade thickness - t_{max}		=	0.075 m	75 mm
	t_{min}		=	0.1 m	100 mm
	average		=	0.0875	87.5
	cover		=	0.014	15
	effective depth d		=	0.061 m	61 mm
5	Self weight of sunshade		=	2.19 kN/ m ²	
	Finishes		=	1 kN/ m ²	
	Live load		=	0.75 kN/ m ²	
		Total		3.94 kN/ m ²	
6	Maximum BM	$W L^2/2$	=	0.71 kN.M	
	"d" req		=	16.02	< 61 mm
					SAFE
7	M_u/ bd^2		=	0.29 N/mm ²	
		P_t	=	0.085	
	Area of steel		=	51.85 mm ²	
	Adopt				
		Y 10		140 mm C/C	
		560.93	>	51.85 mm ²	
			Safe		



Footings and Column Layout
(Stilt + 5)



PLAN SHOWING THE PROPOSED CONSTRUCTION OF HOUSING
RESIDENTIAL APARTMENT BUILDINGS AT SURVEY NO:127/2A, 127/2B1 &
127/2B2 OF KALAPATTI WEST (28) VILLAGE, COIMBATORE NORTH TALUK,
COIMBATORE DISTRICT.

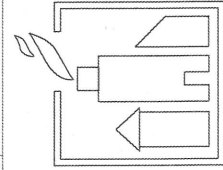
Notes:

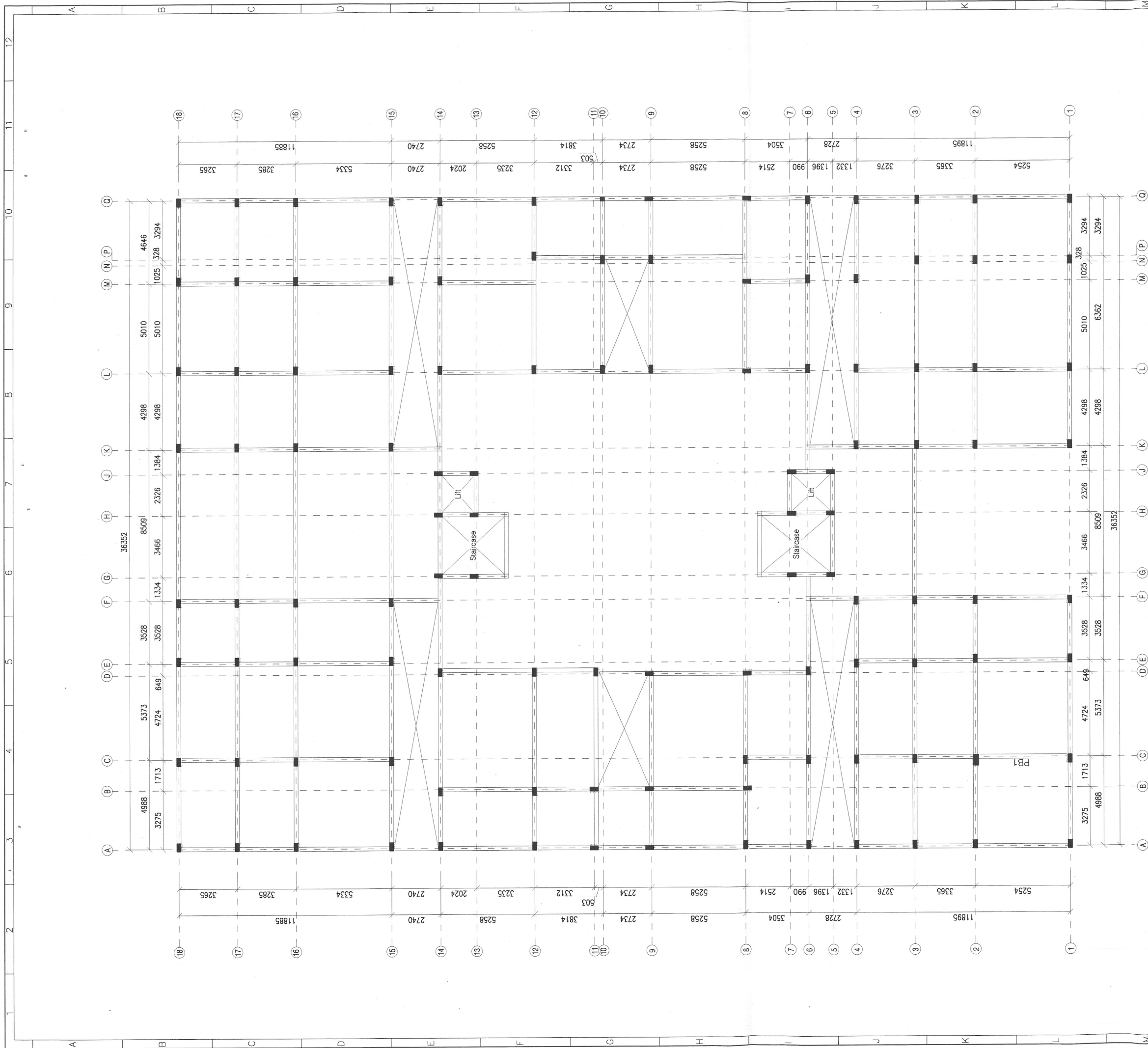
- All Dimensions Are In MM.
- Use Fe415/Fe500 Grade Steel.
- Use Mix M25 For all Works
- Clear Cover To The Reinforcement For Footing:50mm
Column:40mm,Beam:30mm,Slab:20mm,Rec Wall:20mm.

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Mark	Column	Tie Arrangement
C1	6 - Y25 + 4 - Y25 Y10 at 150 c/c	

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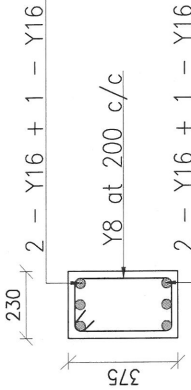


Plinth Beam Layout

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127/2B2 OF KALAPATTI WEST (28) VILLAGE, COIMBATORE NORTH TALUK,
COIMBATORE DISTRICT.

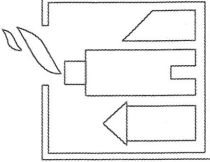
Notes:

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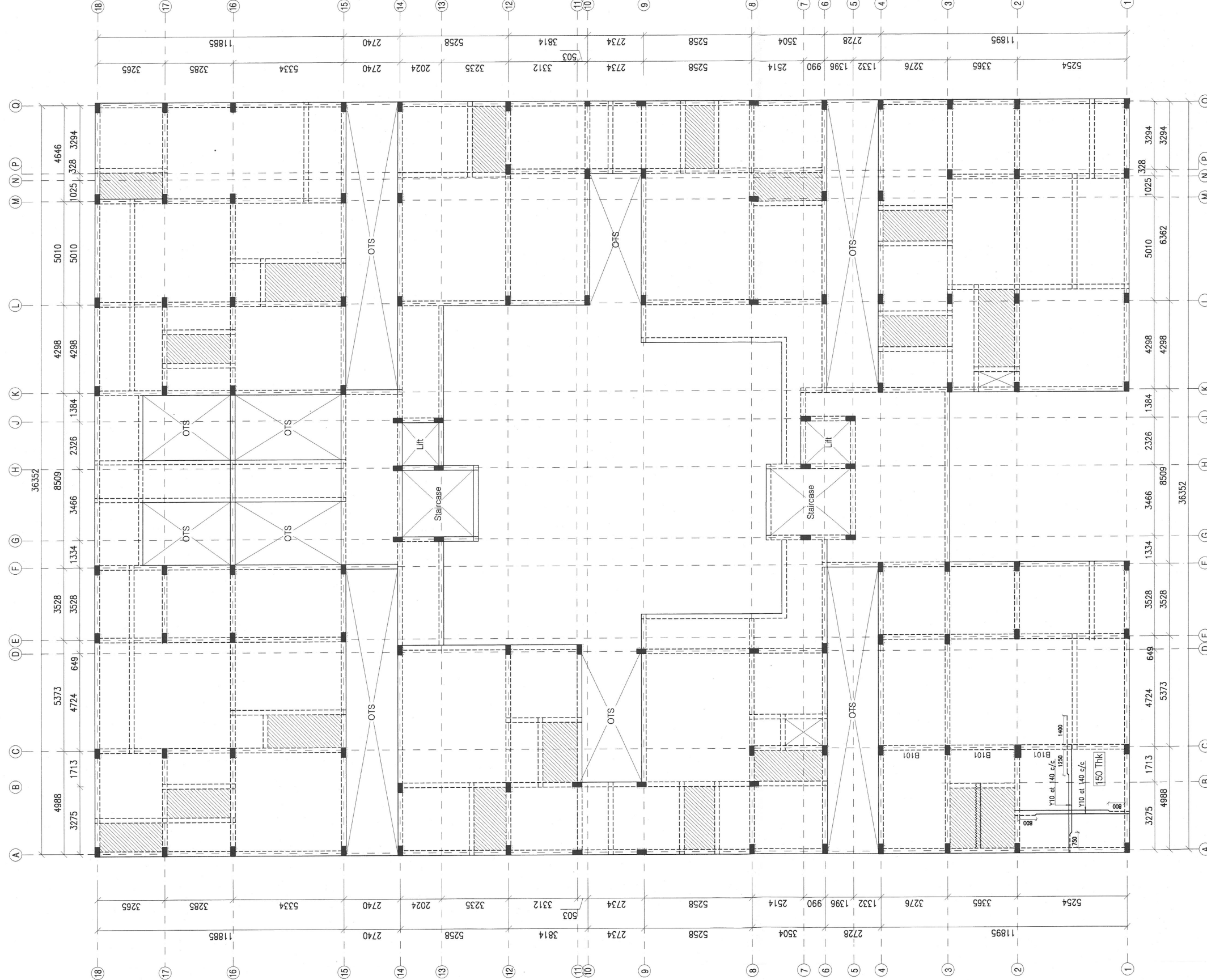


PB1 : 230 x 375

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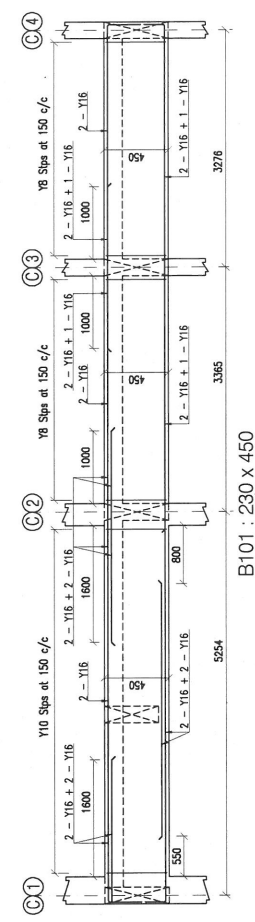
Roof Beam Layout

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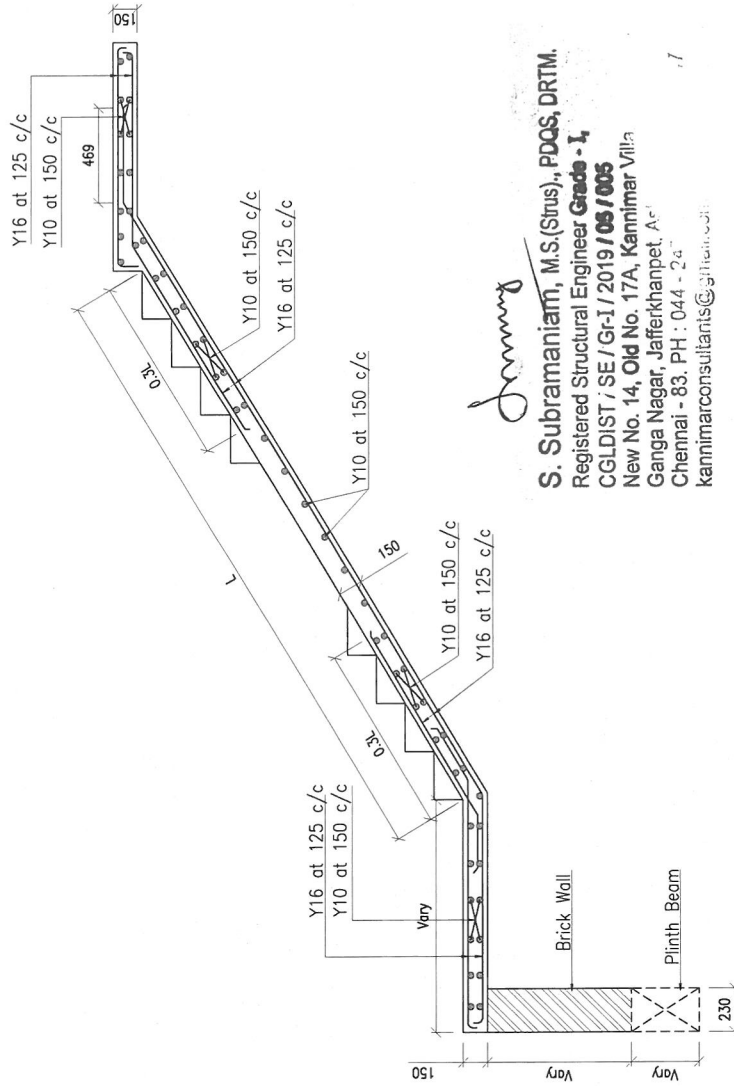
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RESIDENTIAL APARTMENT BUILDINGS AT SURVEY NO:127/2A, 127/2B1 &
127/2B2 OF KALAPATTI WEST (28) VILLAGE, COIMBATORE NORTH TALUK,
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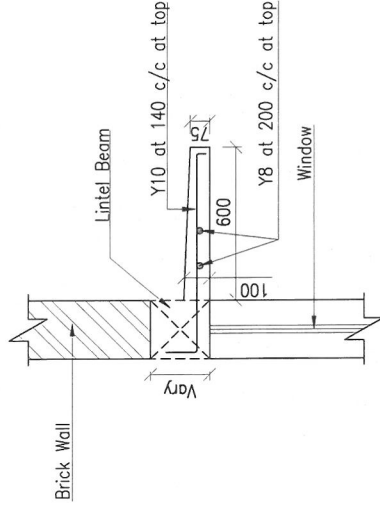


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C.S. of Staircase Details

Sunshade Detail (Typ)

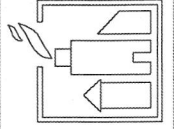


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PLAN SHOWING THE PROPOSED CONSTRUCTION OF HOUSING
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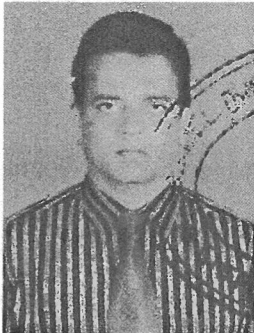
District Town and Country Planning Office,
Chengalpattu District,
D-Block, fourth Floor,
New District Collectorate Complex,
Vedhanarayanapuram, Venbakkam Post,
Chengalpattu District – 603 111.
E-mail : ddcgldistrict@gmail.com, Phone : 044 - 27422144

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that **Thiru. S.SUBRAMANIAM** has enrolled as **Structural Engineer Grade-I (SE)** with Department of Town and Country Planning who has the qualification of **Degree of M.S.,(By Research)** and experience in the relevant field for more than **19 years**.

He/She has been given the Registration No. **CGLDIST/SE/Gr-I/2019/05/005** **Renewed on 30.09.2024**. He/She shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part V, “Registration of Professionals”, Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18 MAWS (MA1) Dept. Dated 04.02.2019.

This Registration is valid upto **29.09.2029**.



[Signature] 30/9/24
Assistant Director,
Chengalpattu District

Self Attested.
[Signature]

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